BEFORE THE
STATE OF NEW JERSEY
BOARD OF PUBLIC UTILITIES

IN THE MATTER OF THE PETITION OF
NEW JERSEY-AMERICAN WATER COMPANY, INC.
FOR APPROVAL OF INCREASED TARIFF RATES
AND CHARGES FOR WATER AND WASTEWATER SERVICE,
CHANGE IN DEPRECIATION RATES AND
OTHER TARIFF MODIFICATIONS

BPU Docket No. WR1709____

DIRECT TESTIMONY OF

GREGORY P. ROACH

Exhibit PT-10

NEW JERSEY-AMERICAN WATER COMPANY, INC.

1. Q. Please state your name and business address.

A. My name is Gregory P. Roach. My business address is 555 East County Line Road, Suite 201, Greenwood, Indiana 46143.

2. Q. By whom are you employed and in what capacity?

A. I am employed by American Water Works Service Company (the "Service Company") as Manager of Revenue Analytics. My responsibilities include leading the Revenue Analytics group, whose main area of focus is the analysis and forecasting of system delivery, customer usage and revenue for the Service Company affiliates, including New Jersey-American Water Company ("NJAWC" or the "Company").

3. Q. What are your responsibilities in this position?

A. I manage and direct a team of financial and regulatory analysts whose responsibilities are to analyze and project customer water usage, system delivery, customer counts and water and sewer sales revenues for each of the American Water affiliate companies. As such, our group supports both the regulatory and financial functions of the Service Company organization and the affiliated American Water companies.

4. Q. Please describe your educational background and professional associations.

A. I graduated from Indiana University in 1980 with a Bachelor of Arts degree in Economics and Political Science. I graduated from Butler University in 1982 with a Master's Degree in Economics. I am a past member of the National Association

of Business Economist and the American Economic Association. I hold the position of Distinguished Toastmaster with Toastmasters International.

5. Q. What has been your business experience?

A. I have over 25 years of experience working in the electric, gas and water utility sectors as both a consultant and utility employee. I began my career with Public Service Indiana (PSI, now Duke Energy) in January of 1980, where my responsibilities included transforming PSI's load forecasting processes from time series to econometric-based models. In May 1982, I accepted the position of Senior Economist with the management consulting firm R.W. Beck and Associates (now part of Science Applications International Corporation), where I was ultimately promoted to Principal Economist. During my career at Beck, I was responsible for the management of all rates and regulatory matters, load forecasting, and financing feasibility client engagements managed by the firm's Indianapolis office. In May 1991, I took the position of Principal Economist with the regulatory management-consulting firm SVBK Consulting Group. There, I was responsible for all consulting engagements executed from the Indianapolis regional office on behalf of SVBK's national utility clients. From July 1993 to November 1998, I was owner and president of a retail operations holding company with three franchise store outlets, and was responsible for all management, operation, sales and financial functions of the firm. In November 1998, I started the Roach Consulting Group, Ltd. As Principal Consultant, I advised industrial and utility clients related to business intelligence systems, enterprise and manufacturing resource planning

systems, customer information systems, and general accounting systems. In July 2011, I joined the Service Company as Manager of Rates and Regulation. In August 2014, I accepted my current position of Manager of Revenue Analytics.

6. Q. Have you previously testified in regulatory proceedings?

A. Yes, I have provided testimony in numerous regulatory proceedings. I have testified before the following regulatory bodies: the Indiana Utility Regulatory Commission, the Missouri Public Service Commission, the Pennsylvania Public Utility Commission, the Public Utilities Commission of Ohio, the Iowa Utilities Board, the Public Service Commission of West Virginia, the Public Service Commission of Louisiana, the Council of the City of New Orleans, the Virginia State Corporation Commission, the Public Utility Commission of Texas, the Arkansas Public Service Commission, the Common Pleas Court of Ohio, the Illinois Commerce Commission and the Federal Energy Regulatory Commission. This is my first opportunity to testify before the State of New Jersey, Board of Public Utilities ("BPU" or "Board").

7. Q. What is the purpose of your testimony in this proceeding?

A. My direct testimony supports the direct testimony of Dante DeStefano regarding NJAWC's Test Year revenue, expense normalizations and the need for a revenue stabilization mechanism ("RSM"). NJAWC has experienced residential declining usage per customer since approximately the year 2000, and my analysis indicates it will continue to experience residential declining usage per customer for the foreseeable future. My testimony discusses the analyses we have performed that

identify and define this declining usage historically and demonstrates that the trend of declining usage will continue beyond the Test Year. These analyses show there is a continuing annual decline in residential water use across all NJAWC districts averaging a combined approximate -1,080 gallons per customer per year ("gpcy"), or approximately -2.959 gallons per customer per day ("gpcd"). Furthermore, the ongoing and significant nature of the residential declining usage trend offers justification for the creation and application of a RSM that will allow NJAWC the opportunity to attain its authorized revenue in this proceeding.

8. Q. Have you prepared, or caused to be prepared, schedules in support of the Company's application to increase rates?

A. Yes, I am sponsoring the following schedules:

- Schedule GPR-1: NJAWC Residential Usage Trend 2007-2016;
- Schedule GPR-2: AWK Residential Usage Trend 2007-2016;
- Schedule GPR-3: US Water Fixture Specifications;
- Schedule GPR-4: State of New Jersey - Housing Stock Vintage;
- Schedule GPR-5: Effect of Tornado Rebuild on Water Usage;
- Schedule GPR-6: Authorized and Actual Revenue & Water Sales; and
- Schedule GPR-7: Household of 4 Theoretical Water Reduction.

9. Q. Please summarize your testimony.

A. My testimony will quantify and estimate the potential term and impact of the declining usage trend of NJAWC's residential customers. My analysis concludes the following:

1. There is a continuing annual decline of residential water use across all NJAWC districts averaging 1,080 gallons per customer.
2. That revised mandated efficiency standards for water fixtures will continue the existing trend of declining usage into the foreseeable future.
3. Similar water use trends as are seen with NJAWC are occurring within affiliated American Water systems.
4. Empirical analysis indicates that the NJAWC use trend
   a. May continue for up to the next 36 years.
   b. Is confirmed by the Joplin case study that illustrates that a significant reduction in usage per household (-8%) can rapidly occur due to water fixture replacement. This reduction is an amount equal to approximately an entire month's level of water sales.

10. Q. Please describe the water use trend among NJAWC's residential customers?

A. Since approximately the year 2003, residential usage has declined on a per-customer basis in the NJAWC service territory. The slope, or change rate, of residential decline has accelerated since the passage of more stringent water fixture and appliance usage regulations in the 2000s. The decline is attributable to several key factors, including but not limited to the following: increasing prevalence of low flow (water efficient) plumbing fixtures and appliances in residential households; customers' conservation efforts; conservation programs implemented by the federal government, state government, NJAWC and other entities; and price elasticity.

11. Q. How did you arrive at your conclusions regarding the current downward trend in usage for NJAWC's customers?

A. Our rigorous analysis of monthly residential customer consumption by NJAWC customers over the past ten years drives our conclusions. For purposes of this analysis, we have divided total residential customer monthly usage into its base, non-weather sensitive usage and non-base, weather-sensitive usage components. We analyzed base usage by applying regression analysis using time as a proxy variable for the ever-increasing penetration of government mandated usage reductions occurring by reason of water fixture and water appliances installed by the NJAWC residential customer base over time. We derived the annual non-base usage by calculating the mean annual non-base usage over the period of 2007 through 2016 and profiling each month using the mean monthly contribution to the mean annual total over that same period. Discrete monthly, non-base usage was estimated using the 10-year average allocation of non-base usage for each month to the 10-year average annual total.

In summary, the per customer trend of base usage was developed as illustrated by the three-step process outlined below. To illustrate this process, I have attached graphs of the calculations described below as Schedule GPR-1, pages 1-3.

1) Monthly residential water sales data over the period of December 2007 to April 2017 were summed, and then divided by the number of customers to yield the average usage per month, per customer. For analysis purposes, we plotted average per-customer monthly usage over the period of December 2007 to April 2017. In

this instance, the time variable (months) was plotted on the x-axis, and the consumption per customer variable was plotted on the y-axis. (Note that water sales data lag behind actual consumption by approximately one month for customers on a monthly meter reading cycle). See Schedule GPR-1, page 1.

2) We calculated average annual residential base consumption, expressed in gallons per customer, for each year from 2007 through 2017 based on the average of the months December through April. We estimated a single point representing the annual average monthly, non-discretionary base (total usage less discretionary, seasonal outdoor usage) usage and it is plotted for illustrative purposes on Schedule GPR-1, page 2.

3) We then applied a linear regression analysis to the resulting annual base usage data to derive a trend line employing the 10-year annual average, non-discretionary usage per residential customer as a function of time that stands as a proxy for the ever-increasing saturation of more water efficient fixtures and appliances. The resulting regression model has a good statistical fit with an R-Square of .962 (meaning the resulting regression model explains approximately 96% of the variance in annual customer usage over the period estimated) and the time variable is very significant in explaining usage per customer with a t-statistic of -13.250. See Schedule GPR-1, Page 3.

12. Q. What are the results of your analysis for residential customers?

A. The results of our analysis indicate that NJAWC has experienced a substantial and continuing decline in residential water consumption over the period covered by the historical data set, December 2007 to April 2017. The regression analysis projects a continuing annual system-wide decline of -1,080 gpcy; this is equal to an annual decrease of -1.54% per year, or approximately -2.96 gallons per customer day.

13. Q. Have you performed a similar analysis of residential base usage for the existing NJAWC rate districts?

A. Yes, I have. Using the same base usage analysis described above to analyze NJAWC system wide residential customer base usage, I have performed an analysis of the trend of base usage for five residential rate schedules. Table GPR-1A presents the results of that analysis. Table GPR-1A illustrates that the results of the rate schedule level modeling generally has similar results as compared to the state level modeling. Rate Schedules A-3 and A-10 show the greatest rate of residential reductions in usage at -1,344 and -1,416 gpcy, respectively. Rate Schedules A-1 and A-5 show the lowest rate of residential reductions in usage at -912 and -648 gpcy, respectively.

NEW JERSEY-AMERICAN WATER COMPANY, INC.

Table GPR-1A
New Jersey American Water
Residential Base Usage Trends
2008-2017

District	R^2	Time	%	g/cust/yr	g/cust/day	Customers
NJAW	0.9619	-13.25	-1.54%	-1,080	-2.96	566K
A-1 (SA1)	0.9876	-23.60	-1.28%	-912	-2.50	347K
A-3 (SA2)	0.8865	-7.31	-1.88%	-1,344	-3.68	206K
A-5 (Manville & 1-D)	0.7698	-4.26	-1.14%	-648	-1.78	4.3K
A-8 (Southampton)	0.7748	-4.91	-2.43%	-1,188	-3.25	0.4K
A-10 (Pennsgrove)	0.8832	-7.20	-2.37%	-1,416	-3.88	4.0K

14. Q. Have you performed a similar analysis of commercial base usage for the existing NJAWC rate districts?

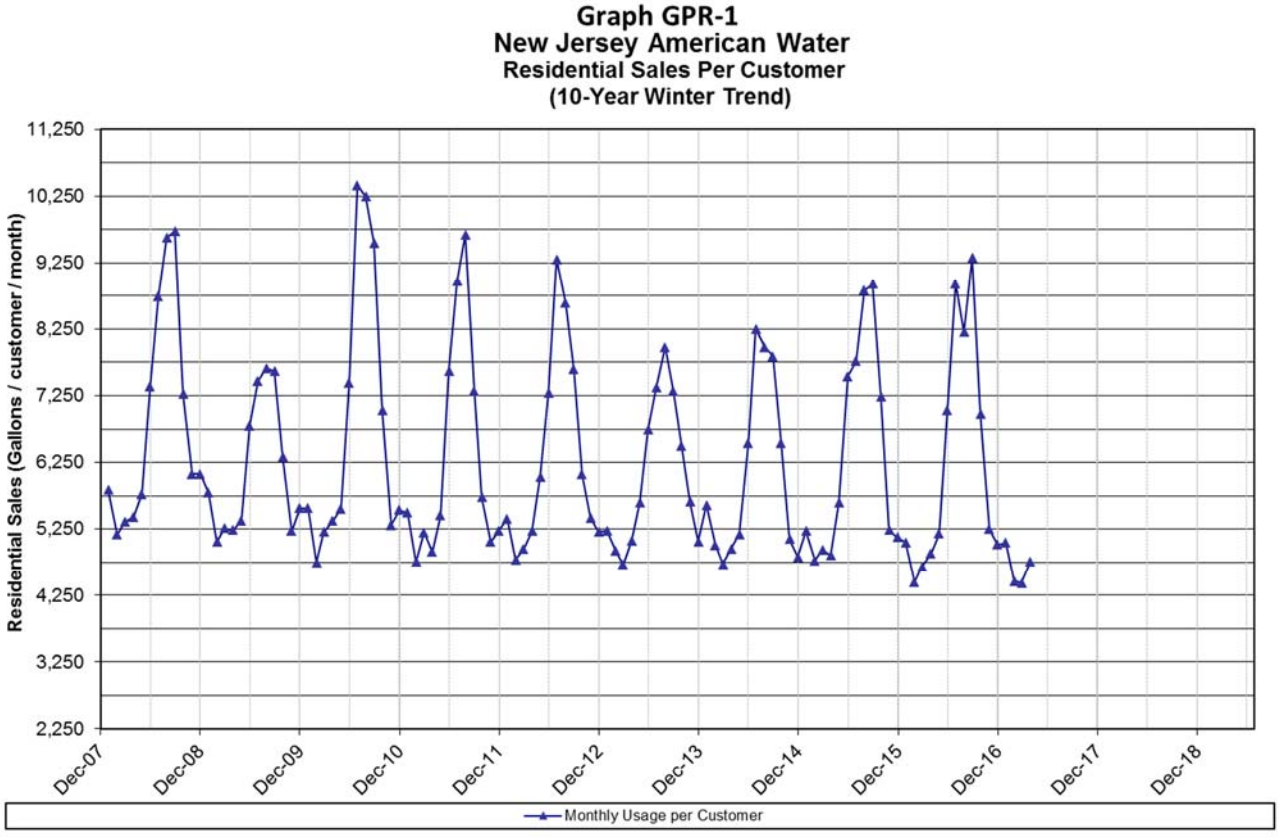
A. Yes, I have. Using the same base usage analysis described above to analyze NJAWC system wide residential customer base usage, but with a base period measured from January through April, I have performed an analysis of the trend of base usage for two commercial rate schedules. Presented in Table GPR-1B are the results of that analysis. Table GPR-1B illustrates that the results of the rate schedule level commercial modeling generally has similar results as compared to the state and rate schedule level residential modeling.

Table GPR-1B
New Jersey American Water
Commercial Base Usage Trends
2008-2017

District	R^2	Time	%	g/cust/yr	g/cust/day	Customers
A-1 (SA1)	0.8277	-2.64	-0.30%	-1,140	-3.12	29K
A-3 (SA2)	0.7604	-3.85	-0.68%	-3,264	-8.94	12K

15. Q. Do seasonal factors affect residential usage?

A. Yes. Outdoor usage by most customers is seasonal. For instance, in the residential customer class, outdoor usage during the summer season includes discretionary usage such as lawn and landscape irrigation, car washing, filling swimming pools, and similar such activities. Short-term summer weather patterns will influence outdoor water use; for instance, lawn irrigation decreases during a rainy period and increases during a dry period. These weather-related fluctuations in usage can mask underlying trends that occur on a monthly basis to non-weather sensitive base usage. Graph GPR-1, below, illustrates the annual pattern of seasonal usage by NJAWC residential customers over the period of 2008-2017.



16. Q. How does your analysis of base usage account for weather-related changes to residential usage affected by seasonal factors?

A. I conducted a regression analysis that trends "base usage" over time without attempting to normalize for weather. As explained above, base (or non-discretionary) usage is defined as the residential average usage per customer measured over the period of December through April of each year, a period in which there is no appreciable outdoor usage of water. In other words, our methodology studies the trending decline of base usage over time having removed the effects of weather by excluding non-base (or discretionary) usage from the data set and hence the analysis.

Base usage is not weather sensitive and, therefore, is a more appropriate metric for studying the trend of residential usage as opposed to some methodology for creating "weather-normalized total usage." This is because there has never been a consistent definition of "weather" for weather normalization purposes, or a generally accepted weather normalization adjustment methodology[1] in the water industry. Further, unlike NJ energy utilities that have authorized weather normalization clauses, existing ratemaking models have never satisfactorily addressed weather for water companies using a regulatory "standard" for weather "normalization". Having said that, water utility weather sensitive usage should not be ignored simply because the interplay of climate and weather sensitive water usage is more complex than

[1] By contrast, degree-days have been determined to be a reasonable measure of 'weather' for the gas and electric industry. In the water industry, the interplay between precipitation and temperature are as important as degree-days in the measurement of water usage.

climatic conditions influencing the energy sector. NJAWC has addressed the impact of climate on its residential and commercial usage by isolating and analyzing that usage into respective weather and non-weather sensitive components. By identifying and isolating the effects of weather sensitive and non-weather sensitive usage, it allows NJAWC to analyze non-discretionary usage having removed the impact of weather, which is a more reliable metric for analyzing the long-term declining usage trend I have described.

17. Q. Given that you have separated water usage into base usage and seasonal, non-base usage, how did you address variations in seasonal usage to arrive at non-base usage billing determinants?

A. I used an average of the non-base weather sensitive outdoor usage for the last ten years because outdoor, seasonable usage is affected by temperature, rainfall, cloud cover and other factors such as the duration of dry weather conditions. Ten years is a long enough period to capture the seasonal variations in non-base weather sensitive usage year over year without being unduly influenced by a singularly abnormal year. That, combined with the trend of declining base usage operate in tandem to produce the best forecast of likely usage in the first year that rates will be in effect.

18. Q. You mentioned that the declining usage per customer experience of NJAWC is not unique among the companies of the American Water system. Have you studied water consumption trends for other American Water subsidiaries?

A. Yes, I have.

19. Q. Are the results of your analysis of NJAWC customers' usage consistent with the results of your analyses in other states?

A. Yes, they are consistent. We have studied the residential consumption patterns for other American Water state operating systems located in climates and geographies similar to New Jersey. The trend experienced by NJAWC is very similar to the trends experienced in other states. The results of my analysis are shown on Schedule GPR-2, which illustrates that states in the American Water footprint have experienced a decline in residential consumption per customer averaging -2.0% per year over the last 10 years. The estimated NJAWC system-wide reduction in residential customer usage per year of -1.54% falls close to the mean, appears reasonable, and is well within the bounds of the comparable rates of decline experienced by similar states in the American Water footprint.

20. Q. Is this trend being observed across the industry, beyond NJAWC and other American Water companies?

A. Yes. According to the 2010 Water Research Foundation ("WRF") report, "many water utilities across the United States and elsewhere are experiencing declining water sales among households."[2] The report further states: "A pervasive decline in household consumption has been determined at the national and regional levels.[3]

[2] Coomes, Paul et al., North America Residential Water Usage Trends Since 1992 – Project #4031, page 1 (Water Research Foundation, 2010).
[3] Id, at xxviii.

21. Q. What is causing the decline in residential customers' usage?

A. A number of factors drive the decline in residential customers' usage. These factors would include the prevalence of low-flow fixtures and appliances, new regulations that lead to further reductions in fixture flow-rates, conservation programs and public initiatives that have led to greater consumer water conservation awareness, consumers' response to price increases for water service or competing products, and consumers' responses to changes in income or employment.

22. Q. Please explain what you mean by the prevalence of low flow fixtures and appliances.

A. Plumbing fixtures such as toilets, showerheads, and faucets available to consumers today are more water-efficient than those fixtures manufactured in the past. Similarly, appliances such as dishwashers and washing machines are also more water-efficient. When a customer replaces an older toilet, washing machine, or dishwasher with a new unit, the new unit will almost certainly use less water than the one it replaced. Similarly, construction of new homes or business establishments result in the installation of water efficient fixtures meeting new, more efficient, regulatory standards. Further, every time a customer remodels or installs new appliances in his or her kitchen, bathroom or laundry room, he or she will consume less water in the future.

23. Q. How much water do the new fixtures and appliances save?

A. The Energy Policy and Conservation Acts of 1992 and 2005 ("EPAct92" and "EPAct05," respectively) mandated the manufacture of water-efficient toilets,

showerheads and faucet fixtures. For example, a toilet manufactured after 1994 must use no more than 1.6 gallons per flush, compared to a pre-1994 toilet, which typically used from 3.5 to 7 gallons per flush. In fact, toilets using only 1.28 gallons per flush or less are becoming more prevalent in the marketplace. Replacing an old toilet with a new one, therefore, can save from 2 to nearly 6 gallons per flush. The United States Environmental Protection Agency ("USEPA") estimates that there are more than 220 million toilets in the United States, and that approximately 10 million new toilets are sold each year for installation in new homes and businesses or replacement of aging fixtures in existing homes and businesses.

The Energy Independence & Security Act of 2007 ("EISA"), which established stringent efficiency standards for dishwashers and washing machines has further reduced indoor water consumption. Dishwashers manufactured after 2009 and washing machines manufactured after 2010 must use 54% and 30% less water, respectively. All other factors being equal, a typical residential household in a new home constructed in 2015, with water efficient toilets, washing machines, dishwashers and other fixtures, uses approximately 35% less water for indoor purposes than a non-retrofitted home built prior to 1994. Schedule GPR-3, pages 1-3 provides additional detail about the expected impact of water efficiency measures on residential water consumption.

24. Q. Haven't new federal regulations related to efficiency standards for water-using fixtures and appliances already had their full impact on NJAWC residential customer usage?

A. No, not at all. Due to the age of the New Jersey residential housing stock, these water efficiency standards have only just begun to have an impact on New Jersey residential usage. The potential impact of replacing these fixtures is significant as, according to the 2015 American Housing Survey, 89% of the homes in the State of New Jersey were built prior to the year 2000 (80% of homes prior to 1990).[4] Schedule GPR-4 details this data, which is summarized in Table GPR-2, below. This data illustrates that 80% or more of the New Jersey housing stock was

Table GPR-2
New Jersey American Water Company
Housing Stock Vintage
State of New Jersey

Year Structure Built	State of New Jersey Units	% Total
Built 2014 or later	2,789	0.08%
Built 2010 to 2013	33,290	0.93%
Built 2000 to 2009	347,058	9.70%
Built 1990 to 1999	330,373	9.23%
Built 1980 to 1989	420,741	11.76%
Built 1970 to 1979	461,826	12.91%
Built 1960 to 1969	491,252	13.73%
Built 1950 to 1959	558,961	15.62%
Built 1940 to 1949	286,220	8.00%
Built 1939 or earlier	645,432	18.04%
Total housing units	3,577,942	100.00%
Percentage Prior to 00		89.29%

[4] U.S. Census Bureau, Selected Housing Characteristics. 2014 American Community Survey 10-Year Estimates (1990-1999), *available at h*ttp://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

constructed with toilets, washing machines, and dishwashers that are much more water-intensive than newer fixtures and appliances now on the market that will eventually replace the existing fixture and appliance stock.

25. Q. Please elaborate on other factors contributing to the continued decline in residential water consumption patterns.

A. Programs to raise customer awareness and interest in the benefits of conserving water and energy continue to increase. For example, WaterSense is a USEPA voluntary partnership program that seeks to protect the future of our water supply by offering people a simple way to use less water with water-efficient products, new homes, and services. Schedule GPR-3, pages 4-12 detail these program's specifications as well as others. This listing is a reproduction of the Alliance for Water Efficiency Water Products Standard Matrix, which was last updated in March 2010. In addition, NJAWC witness Kevin Kirwan describes how NJAWC encourages customers to use water efficiently. As awareness of water efficiency increases, customers may decide to replace a fixture or appliance even before it has broken. Additionally, customers may further reduce consumption by changing their household water use habits in various ways. NJAWC's residential customers have reduced their base usage by approximately 2.5 gpcd on average, since 2007. Thus, subtle changes in customer behavior can achieve a 2.5 gallon per day decrease in customers' usage. For instance, here are some ways a customer can reduce his or her usage by 2.5 gallons per day:

- Taking a shower that is 1 minute shorter per day;

- Two flushes per day with a newer replacement low-flow toilet fixture vs. an older toilet;
- Running the dishwasher 5 times per week instead of 7; or
- Turning off the water for approximately 1 minute while brushing your teeth.

In addition, negative price elasticity can contribute to a reduction in usage. As the price of water has increased over time with successive rate increases, as with typical consumer price responsive behavior, water consumers reduce their usage in response to those successive price increases.

26. Q. The Post Test Year in this case ends September 30, 2018. Given that the declining use trend has been progressing for over two decades, won't the majority of non-efficient fixtures and appliances already be replaced by the end of that period?

A. No, as illustrated above, the steady replacement of older fixtures due to remodel or failure as well as new construction will result in many years to achieve complete implementation and saturation of fixtures and appliances consistent with the current efficiency standards. This occurs over a very long period of time as housing stocks are remodeled and appliances and fixtures wear out, break or become obsolete. As explained later in my testimony, the decline in usage for the theoretical family of four indicates a 50-year term to reach total implementation of the current fixture standards and realize the total impact in reduced water usage. As mentioned earlier in my testimony, to date, we have observed an increasing trend of declining

residential usage on the NJAWC system for approximately 14 years, leaving another 36 years for further reductions.

27. Q. You have explained the laws and programs that drive the water conservation trend. Can you identify a "real world" example of how these laws and programs actually affect usage per customer?

A. Yes. As a matter of fact, there was a situation in the American Water footprint that demonstrates this phenomenon in a rather dramatic fashion.

28. Q. Please describe it.

A. Illustration of this phenomenon is accomplished by analyzing usage per customer in the Missouri-American Water Company ("MAWC") Joplin district, before and after the devastating EF5 tornado of May 22, 2011 ("Joplin Tornado"). Although this tornado affected the MAWC service area, the results of my analysis would be applicable to New Jersey and NJAWC.

29. Q. How does the Joplin tornado provide evidence of future declining water use for NJAWC?

A. The impact of the Joplin Tornado was an immediate reduction of customer connections in the Joplin district by approximately 3,060 (14.4% of the May 2011 Joplin residential total). Given that the devastation caused by an EF5 tornado to residential housing is nearly absolute, it follows that the 14.4% of the Joplin district residential housing stock would require rebuilding before again being habitable. Such new rebuilding would be required to conform to the water use standards

discussed earlier in my testimony. Further, detailed in NJAWC Schedule GPR-7 is the theoretical scope of such replacement on a NJAWC system wide basis. Hence, this event has implications for the potential future usage decline due to fixture replacement for the entire American Water affiliate system, including but not limited to NJAWC.

30. Q. Please describe the statistical results of your analysis of the pre- and post-2011 Joplin tornado residential customer usage?

A. The results of the analysis are provided in Table GPR-3, below:

Table GPR-3
Joplin Declining Use Analysis
Usage Trend Pre / Post-2011 Tornado

Measure	Prior to 2011	Post 2011
R-Square	0.855	0.987
Usage Trend	-2.02%	-2.77%

Table GPR-3 illustrates the results of the regression analysis of average base usage per customer both before and after the Joplin Tornado. It is clear from the statistical results of that regression analysis that the Joplin district's declining usage per customer trend has accelerated because residential customers have rebuilt using water use fixtures that meet or exceed the contemporary water efficiency standards and have replaced older, less efficient fixtures as part of the rebuilding process. The results show that the decline in the base residential usage per customer has increased from an annual rate of approximately -2.0% to approximately -2.8% due

to the reconstruction of approximately 2,500 (13.8% of that system) residential dwellings since May 2011 in the Joplin district. This is an approximate 37% acceleration of the rate of decline in Joplin post May 2011. NJAWC Schedule GPR-5 graphically illustrates the acceleration of the trend.

31. Q. What is your conclusion related to the continuation of reductions in residential water usage on the NJAWC system?

A. Typically, households replace appliances on a sporadic basis, as they break or become obsolete. As they are installed over time, the replacement appliances being more efficient then the originals, result in reductions in usage due to increased efficiency that are spread out over time making it difficult to isolate the impact of any increase in the efficiency of a single appliance on overall water usage. In contrast, households affected by the Joplin Tornado replaced all of their appliances at a single point in time. Therefore, by analyzing the decline in usage in Joplin after the tornado, we can assess the total impact that installation of the most recent, efficient, available technology will have on usage over time. In other words, as NJAWC customers replace their appliances, usage on the NJAWC system is likely to decline at a similar rate as usage in Joplin declined after the tornado. On this basis, and in conjunction with the results of the theoretical family of four analysis (see Schedule GPR-7), I conclude that residential water use reductions will continue to be significant well into the near future for the NJAWC system.

32. Q. Have you analyzed the impact of reduced water usage on NJAWC's actual water sales and revenues, as compared to levels authorized for the Company since 2008?

A. Yes, I have. NJAWC Schedule GPR-6, and summarized in Table GPR-4 below, illustrates that NJAWC has collected revenue that is less than the revenue levels used to set revenue requirements in rate cases since 2007 for each post-case year of those proceedings from 2007 to 2016 except for 2015/2016, when sales were driven by unusually dry summer climate. More specifically, for the period of 2007 through 2016, NJAWC was under the revenue used to establish rates for the period by approximately $127.5 million. Similarly, for that same period, NJAWC was under total water sales used to establish rates revenue levels by approximately 16.984 billion gallons. There is direct linkage between the inability of NJAWC to collect this revenue level over the period of 2008-2016 and water usage reductions attributed to the 16.984 billion-gallon short fall in total sales levels utilized in the NJAWC cases over the period of 2008 through 2016.

Table GPR-4
New Jersey American Water Company
Actual Revenue/Water Sales Compared to Utililzed
(2007-2016)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total 2007-2016
NJWC Total Billed Annual Revenue*	369,696,285	370,184,478	410,469,866	432,198,459	439,676,035	461,162,881	450,704,130	457,426,392	485,970,924	522,731,814	4,400,221,264
Total Authorized Revenue**	397,460,127	400,554,949	439,739,115	439,739,115	454,158,610	467,680,838	473,360,865	473,360,865	479,799,180	501,912,152	4,527,765,816
Revenue Recovery to Authorized (Under)/Over	($27,763,842)	($30,370,471)	(29,269,249)	(7,540,656)	(14,482,575)	(6,517,957)	(22,656,735)	(15,934,473)	$6,171,744	$20,819,662	($127,544,552)
	-6.99%	-7.58%	-6.66%	-1.71%	-3.19%	-1.39%	-4.79%	-3.37%	1.29%	4.15%	-2.82%
NJWC Total Annual Water Sales (000 Gallons)	63,919,872	67,709,287	62,198,523	68,349,122	63,430,775	63,855,472	60,752,397	61,405,819	64,430,499	63,682,367	639,734,133
Total Authorized Water Sales*	67,960,133	68,003,830	68,557,095	68,557,095	65,194,420	64,518,209	64,234,167	64,234,167	63,680,610	61,779,369	656,719,095
Water Sales to Authorized (Under)/Over	(4,040,261)	(294,543)	(6,358,572)	(207,973)	(1,763,645)	(662,737)	(3,481,770)	(2,828,348)	749,889	1,902,998	(16,984,962)
	-5.95%	-0.43%	-9.27%	-0.30%	-2.71%	-1.03%	-5.42%	-4.40%	1.18%	3.08%	-2.59%

*GMS only. Exclusive of DSIC and Surcharge and Other Water Revenue
**GMS only. Per Commission Orders Exclusive of Other Water Revenue

33. Q. Has NJAWC factored the observed trend in residential customer usage into its pro-forma revenues in this case?

A. Yes. Company witness Dante Destefano addresses the development of NJAWC's revenue requirement and pro-forma revenues at present rates, including the adjustment to Base Year data to reflect the observed trend in residential customers.

34. Q. Do you expect the NJAWC customer declining usage trend to continue in the future?

A. Yes. Water efficient fixtures and other drivers such as conservation education and federal government-mandated standards will continue to drive further water efficiency and hence an ongoing decline in usage per residential customer. The rate of the continued trend depends on the pace of fixture replacement within the NJAWC service footprint. Further influencing the rate of reduced usage is the broadening acceptance of a conservation ethic through raised residential customer and business awareness programs, government conservation policy, and similar behavior modification related programs.

According to an American Water Works Association ("AWWA") Journal article dated February 2012, technology is now available for newer, more water-efficient products that further improve Energy Policy Act levels, and there is a growing movement to codify these more stringent specifications[5]. The recent introduction of progressive code modifications—such as the International Code Council's

[5] Hoecker, Jay and Bracciano, David. Tampa Bay Water. "Passive Conservation: Codifying the use of Water-Efficiency Technologies" February 2012, Journal AWWA. 104:2.

("ICC's") International Green Construction Code ("IGCC") and the International Association of Plumbing and Mechanical Officials ("IAPMO") Green Plumbing and Mechanical Code Supplement (2011) support uniform implementation of increased water efficiency standards.[6] AWWA research also indicates that this decline in water consumption will continue. An article in the June 2012 issue of the AWWA Journal entitled "Insights Into Declining Single-family Residential Water Demands" states: "[r]educed residential demand is a cornerstone of future urban water resource management. Great progress has been made in the last 15 years and the industry appears poised to realize further demand reductions in the future."[7] The regulations mandating water efficient washing machines and dishwashers are relatively new. Given the life expectancy of appliances, the replacement of existing appliances, and the corresponding reduction in water used, will likely continue to occur for the next fifteen years or more**.**[8]

35. Q. Is the decline in residential water consumption showing any sign of reaching an equilibrium?

A. The trend of decline in residential water consumption in the NJAWC service territory shows no signs of ending any time soon. New water efficiency technology

[6] Hoecker, Jay and Bracciano, David. Tampa Bay Water. "Passive Conservation: Codifying the use of Water-Efficiency Technologies" February 2012, Journal AWWA. 104:2.

[7] DeOreo, William and Mayer, Peter. American Water Works Association Journal. Vol. 104. Issue 6. http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0076117. June 2012

[8] As I mentioned earlier, EISA will further reduce indoor water consumption. The average life expectancy of a new dishwasher, clothes washer and gas water heater is 11 years. An electric water heater has an average life one year longer. http://www.statista.com/statistics/220020/average-life-expectancy-of-major-household-appliances. Consequently, it should be obvious that the trend of declining use due to appliance replacement will continue for years to come.

and regulations will continue to drive water use downward in the future. As explained by the American Council for Energy Efficiency:

> Home appliance manufacturers and energy efficiency advocates have recently agreed to improved efficiency standards and tax policies for refrigerators, freezers, clothes washers, clothes dryers, dishwashers, and room air conditioners. This agreement could save enough energy to meet the total energy needs of 40 percent of American homes for one year and the amount of water necessary to meet the current water needs of every customer in the City of Los Angeles for 25 years.[9]

These higher efficiency dishwasher and washing machine standards include tax incentives for consumer purchases that became effective in January 2013 and January 2015, respectively. Therefore, consumers will achieve an even higher level of water efficiency (i.e., lower usage) than the federal regulations mandated in the EPAct92.

36. Q. Have you performed an analysis of the likely future of the declining use trend for NJAWC?

A. Yes, I have developed estimates of the impact of the Water Sense/Energy Star usage specifications for a family of four occupants' water usage. NJAWC Schedule GPR-7, page 1 depicts the results of this analysis. Generally, the model multiplies the typical usage per capita by the estimated reduction for specific appliance usage from the pre-regulatory standard in place until 1994 to the Water Sense/Energy Star

[9] American Council for Energy Efficiency, Major Home Appliance Efficiency Gains to Deliver Huge National Energy and Water Savings and Help to Jump Start the Smart Grid, *available at* http://aceee.org/press/2010/08/major-home-appliance-efficiency-gains-deliver-huge-natio. Date Accessed: 8/7/2012.

usage specifications in effect since 2010/2011 respectively, by the number of users in the household (4 in this example), annualized. I then summed the various usage reductions for the sample family of four across all fixtures that could be replaced to get an average total usage reduction. My analysis indicates that a household of four would see a reduction of approximately 54,315 annual gallons over the course of a year, due to fixture replacement at the Water Sense/Energy Star specification levels.

37. Q. Do the validity and applicability of the household of four analysis require that all four of the theoretical users reside in the same household?

A. Not at all. The household of four analysis is what economists and statisticians refer to as a stochastic analysis. A stochastic analysis implies that the data sample is randomly selected and distributed across the population of the data being analyzed. In this particular instance, stochastic selection means that the household of four is spread throughout multiple households across the NJAWC service territory. In practical terms it means that the necessary number of toilet, water fixture, water heater, clothes washer, etc. replacements occur throughout the NJAWC service territory to equal the number of replacements implied by the analysis and the annual amount of residential declining use. As an example, the analysis implies that 11,216 toilets are replaced annually among the 564,072 (1.99%) residential customers across the NJAWC system.

38. Q. What does the estimated 54,315-gallon annual reduction in usage for a household of four imply related to the potential term of the declining use trend that you have estimated for NJAWC?

A. The estimated reduction in usage of the sample household of four analysis allows for the estimation of the time period over which all appliances in the NJAWC service territory will be converted to meet the Water Sense/Energy Star specifications. That time period was derived by dividing the total estimated annual usage decline for NJAWC of 609 million gallons, by the estimated annual usage decline for the sample household of four of 54,315 gallons. The result reveals that 11,216 residential customers, or 1.99%, of the test year average of 564,072 residential customers, would need to make these fixture changes to account for the estimated total annual residential declining usage. Further, taking the reciprocal of the 1.99% of residential customers needed to account for the annual usage decline reveals a theoretical term of 50 years to convert the installed fixture base to the Water Sense/Energy Star usage specifications, all other factors remaining equal.

39. Q. Conceptually, how many additional years could the estimated declining use trend for NJAWC continue?

A. Based on the historical data available for NJAWC; the current declining use trend has been evident since 2003. To date, that trend has progressed for 14 consecutive years. Given that the implied theoretical term of the trend is 50 years, all factors staying the same, the trend could continue for an additional 36 years at the current water efficiency standards. Future revisions to these efficiency standards or new technological innovations would work to further extend this trend beyond the remaining 36 year term.

40. Q. Have the Company's residential customers received any benefits from their reduced water usage?

A. Yes. Residential customers share in various environmental and operational benefits from lower water usage by residential customers. For example, reduced usage helps maintain source water supplies, lessening diversions from supply sources, leaving more water for passing flows or drought reserve. Reductions in power consumption, chemical usage, and waste disposal not only reduce water utility operating costs, but also provide environmental benefits such as reduced carbon footprint from lower power usage for treatment and pumping and reduced waste streams. Reduced water usage by residential customers also reduces energy consumption within the customer's home, for instance, through lower hot water heating needs. In addition, on a case-specific basis, reduced water usage has the potential to enable the utility to delay or downsize a capacity addition. In systems where demand is approaching the capacity of water supplies or treatment facilities, the water saved through efficient usage by customers can be a preferred alternative to a supply-side expansion, with a resulting lower cost to customers. Over the long term, reduced usage per residential customer has helped lower operating costs, and has helped avoid some capacity-related needs. These savings and avoided costs have benefitted customers through the ratemaking process.

41. Q. Please describe how declining usage and water conservation activities can result in certain avoided capital costs.

A. As discussed previously, the decline in residential water consumption has been steadily progressing since the early 2000's. Base water consumption for the average NJAWC residential customer is approximately 21% lower today than it was in the early 2000's. Because of these ongoing reductions in water usage, the water utility industry as a general matter has avoided the need to build supply, treatment, and transmission facilities to meet those now avoided additional usage demands. The impact of reduced usage per customer on supply and large transmission investment notwithstanding, the ongoing decline of usage per customer does not delay nor mitigate the on-going need for NJAWC to continue replacing its aging distribution infrastructure in order to continue providing its customers with reliable and safe drinking water.

42. Q. What conclusions were you able to draw concerning the historic water usage trends of NJAWC customers as well as the degree and length of potential future water usage reductions into the future?

A. First, over the period of December 2007 to April 2017 NJAWC residential customers' base usage fell 1,080 gpcy or approximately -1.54% per year. Second, there is potential for this trend to continue for up to 36 more years on the NJAWC system. Third, housing stock data indicates that over 89% of the residential structures in New Jersey were built prior to the passage of contemporary water use standards, which implies that a vast inventory of water fixtures and appliances currently exists that when replaced, will result in large reductions in household water usage. Lastly, NJAWC has not achieved BPU-utilized revenue levels in

some time, with an accumulated revenue deficiency of $127.5 million over the period 2007-2016. As discussed by Mr. DeStefano in his direct testimony, Exhibit PT-5, the leading cause of this failure to achieve the revenue anticipated in Commission orders is the continued reduction in water usage by NJAWC customers, which can render inaccurate and misleading the use of historic year data as a proxy for rate year revenue. There is direct linkage between the inability of NJAWC to meet its utilized revenue over the period of 2008-2016 to water usage reductions that have contributed to the 16.984 billion-gallon short fall in total sales levels utilized in the NJAWC cases over the period of 2008 through 2016. As a result, it is necessary to incorporate the continuing trend of reduced usage per customer for residential customers into the future.

43. Q. Does this conclude your direct testimony?

A. Yes it does.